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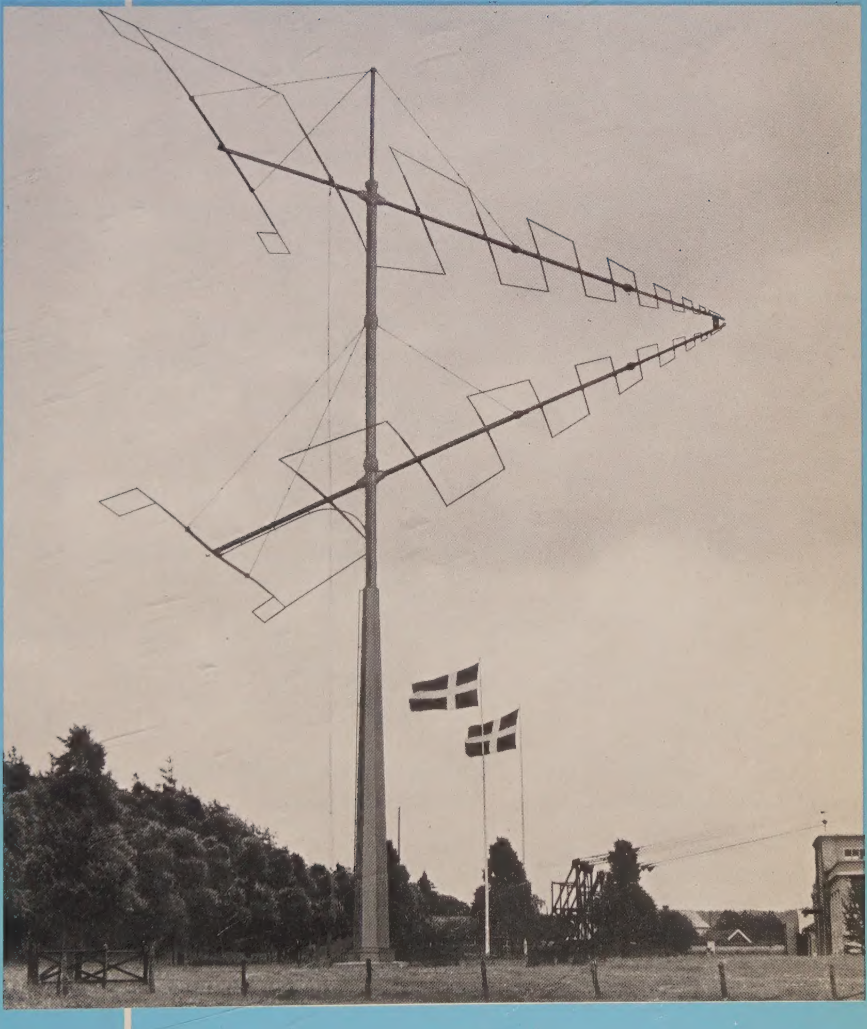

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DECEMBER 61

ROHDE & SCHWARZ MÜNCHEN 8

Submitted by:

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TV Measurements Using the Oscilloscopes Types OHF, OVF and OMF*

At this meeting we introduce a number of new instruments for television engineering, in particular for TV monitoring and measurements. The introductory simple comments on basic television problems may elucidate the special conditions governing the measurements on the television signals and their transmission systems.

The picture to be transmitted is scanned, for its brightness, in horizontal lines, beginning from the top left as in reading a book, by an electronic scanning circuit. The different brightness values are converted into proportional electrical values, which permit the information of the brightness distribution of each line to be transmitted over long distances by wire or by broadcasting or radio transmitters. The scanning sequence and the jumping from line to line are accurately timed. The timing action is impressed as a sync signal on the electrical information of the picture, i. e. the picture signal, in order that at the receiving end the brightness information can be combined in accurate synchronism with the scanning to recreate the picture. Mutual interference between the two signals is avoided by blanking the picture signal during the duration of the sync signals. No disturbance is introduced thereby, since delays are caused anyhow at these points by the return of the electron beams at the pickup and reproduction ends from the right to the left and from the bottom to the top picture edge. A complete television signal is thus composed of three separate processes.

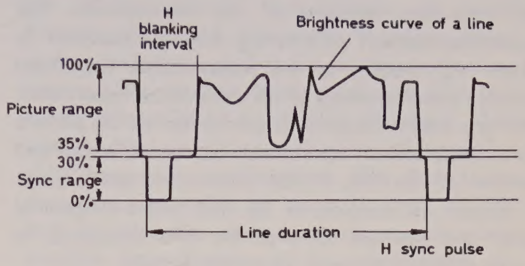

Fig. 1. Line period

The resulting composite video signal is referred to hereinafter also as video-frequency signal.

The sync signal is composed of two timing signals:

(a) Timing signal for the vertical picture frequency –V–

(b) Timing signal for the horizontal line frequency –H–.

Since both are transmitted together in the sync signal they must differ in time. This may be understood more easily by referring to Figs. 1 and 2.

The H sync signal is shown in Fig. 1. The V sync signal is represented spread in time in Fig. 2.

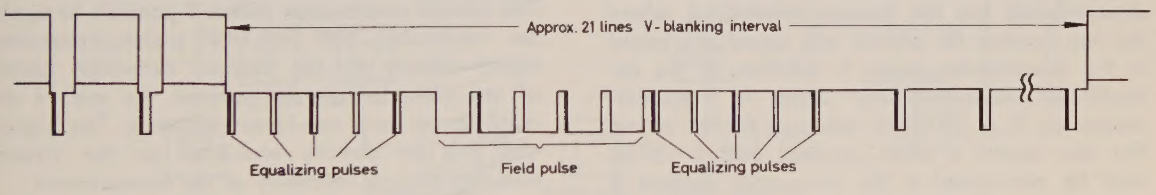

Fig. 2. Picture sync pulse

1. Picture signal conveying the brightness information.
2. Blanking signal interrupting the picture signal during the duration of the sync pulses.
3. Sync signal timing the jumping from line to line and from the bottom to the top edge of the picture.

It can clearly be seen that the V sync signal is interrupted at the line or half-line frequency to avoid disturbance in the line-frequency period. It may be added that in television transmissions even and odd lines are scanned alternately during the individual periods (interlacing). The individual scanning periods are called fields; two fields give a picture period.

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* This paper was delivered as a lecture at the Rohde & Schwarz representatives' meeting in Munich at the end of September, 1961.

It is a requirement for all sections of a TV transmission link that the composite video signal be transmitted with the least possible distortion. Because of the great variability of the picture signal, resulting from the extreme variety of brightness distributions of the picture scanned by lines, it is possible that the total amplitude and frequency ranges are covered permanently.

The individual sections of the transmission link require permanent monitoring during operation to ensure high quality of the transmission. Continual accurate measurements of all transmission characteristics are also necessary, in particular on the picture transmitter, which constitutes the most important member of the link. In the picture transmitter, the RF carrier is modulated by the video-frequency signal and emitted. One of the two sidebands is greatly reduced to save frequency bands.

Careful monitoring of the modulation process is necessary to obtain optimum use of the picture transmitter. Apart from the rated power it is the careful adjustment of the modulation depth that determines the coverage of the transmitter. The more the carrier is modulated, the stronger is the modulating picture signal available at the receiver for scanning the picture on the screen of the picture tube. The signal-to-noise ratio will also assume more favourable values. If the modulation voltage is too high overmodulation may result. With negative modulation, as conventionally used in Germany, this would cause strong compression of the sync signals. Heavily distorted sync signals would give poor synchronization of the television receivers and the synthesis of the picture would be endangered.

Another reason why the picture transmitter must not be modulated too deeply is the fact that our modern television receivers no longer use the parallel-sound method (where the modulated picture and sound carriers are separately amplified and demodulated) but the intercarrier method, where the two carriers for picture and sound are mixed in the demodulator stage. In addition to the demodulated video-frequency signal a frequency-modulated IF of 5.5 Mc ist obtained for the sound. For this reason a given residual picture carrier must be maintained if the intercarrier method is used for the sound transmission; this is ensured only if the modulation depth is below 100%.

The optimum modulation adjustment of the television picture transmitter has thus to fulfill two conditions:

1. Undisturbed reception within a wide service area by attaining the rated power without overmodulation and by the maximum possible modulation depth.
2. Undisturbed sound transmission for the intercarrier method by an appreciable residual carrier, consequently small modulation depth.

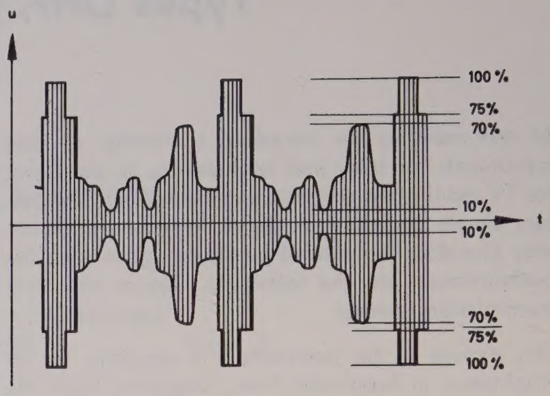


Fig. 3. Modulation of the RF carrier (negative modulation).

As an optimum value a modulation depth of 90%, corresponding to 10% residual carrier, was found. The modulation envelope with correct modulation of the RF carrier is shown in Fig. 3.

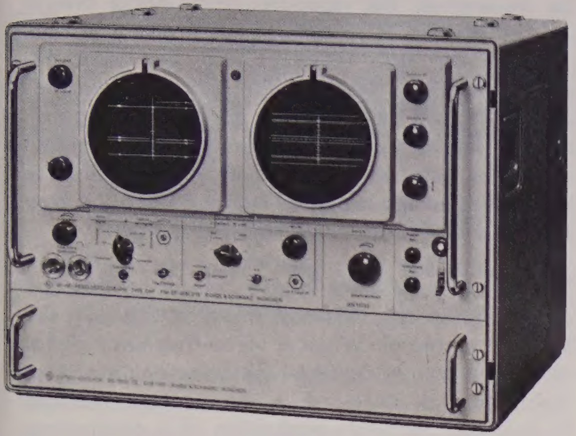
The foregoing considerations show how important it is to check these adjustments of the transmitter. Up to now a double-sideband demodulator with zero reference was used. The zero-reference line was created by complete blanking of the signal during a short time. The accuracy of the indication of the residual carrier depended on the linearity of the demodulator or on its accurate compensation, and the latter was very critical, especially in the range of low carrier voltages.

The VF-RF Level Oscilloscope Type OHF (BN 1913...)

This special oscilloscope makes it possible to apply the modulated VHF or UHF picture-transmitter signal directly to the vertical deflection plates of the cathode-ray tube without the use of an amplifier or any non-linear elements. The signal can thus be directly evaluated on the screen, ensuring extreme reliability of the measurement.

For methodical and economical use this direct-indicating oscilloscope is combined with a high-grade oscilloscope such as commonly used in all picture transmitters for video-frequency monitoring. In addition, the instrument contains a double-sideband demodulator, which is well linearized in the picture range but does not have a zero reference since the residual carrier is directly measurable on the RF oscilloscope tube. All other measurements in the picture range are made in the same way as via a conventional double-sideband demodulator.

With the Type OHF it is possible to ovserve at the same time on two adjacent screens the transmitter

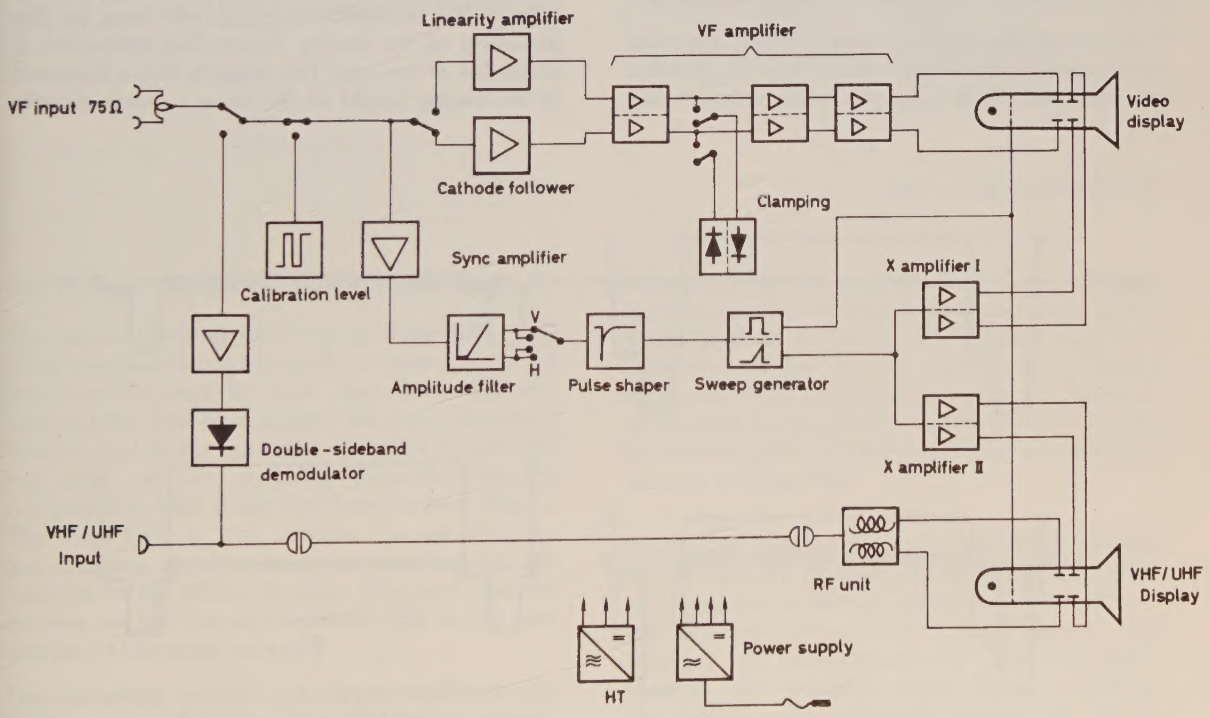


VF-RF-Level Oscilloscope Type OHF

output signal and the video-frequency signal (or the demodulated RF signal after changeover to the built-in double-sideband demodulator).

Technical details are shown in the block diagram of Fig. 4. The deflection voltages for writing the time axis are supplied for both oscilloscopes by a common time base. With the adjustment of the sweep time the associated sync voltage is switched simultaneously to simplify operation. The sync signal is derived ahead of the video amplifier. Since this amplifier can be switched over to the double-sideband demodulator, the synchronization is accomplished either by the video-frequency signal applied or by the RF signal demodulated by the double-sideband demodulator. An amplitude filter separates the signal into V pulses timing the picture frequency and H pulses timing the line frequency. The built-in broadband amplifier has an amply dimensioned bandwidth of about 12 Mc to provide the necessary deflection voltage for the video-frequency oscilloscope. The flat frequency response, presenting an error as small as ±0.1 db at 5 Mc, and the good transient response make it possible to evaluate with this oscilloscope all test signals that are necessary for monitoring a picture transmitter.

A high-pass filter permitting the evaluation of the test signals for linearity measurements with the intermodulation method can be connected in the input in the same way as for our Precision Oscilloscope Type OMF.



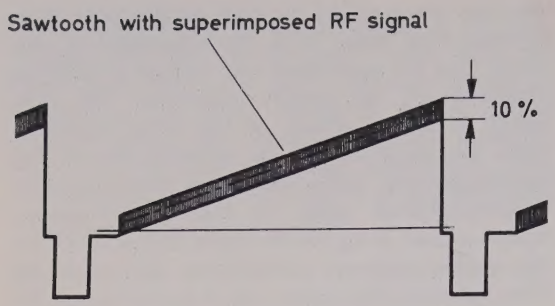


Fig. 5. Test signal for linearity measurement
Sawtooth with superimposed RF signal

The modulation linearity in the picture range of a test item can be measured very accurately by this method. According to Fig. 5 a sawtooth runs with the line frequency through all voltage values comprised in a picture from black to white. The superimposed RF signal has an amplitude of 10% of the sawtooth amplitude and is carried by the sawtooth voltage through the range of modulation of the test item; thus it explores the respective part of the characteristic of the valve and of the other non-linear elements, while measuring the gain. An accurate measure of the variation in slope or the linearity of the test item is obtained at the output. Because of the inserted high-pass filter, only the superimposed RF signal is displayed. The non-linearity appears as ondulation of the envelope, since the magnitude of the RF signal after the test item accurately shows whether the gain undergoes any variation at individual points of the characteristic, particularly in the case of heavy modulation.

Variation of the picture content makes accurate measurements impossible unless special facilities are employed. Since only alternating voltages can be transmitted, the video-frequency signal always adjusts itself so as to enclose equal areas on both sides of the zero reference line. The video-frequency signal of mainly white picture content lies deeper (Fig. 6a) than that of a dark picture (Fig. 6b). Since in the course of an emission the picture signal alternates between light and dark sequences, the distribution of the television signal around the zero reference line varies continuously (Fig. 6c).

The zero reference line is given on an oscilloscope screen by the adjustment of the time axis with the Y position control. When a video-frequency signal of varying picture content is observed on the screen, the pattern is displaced in the vertical direction (Y direction). Accurate evaluation of a programme signal and observation of the sync signals would thus be impossible. This effect is eliminated by displacing upwards all voltages lying below the zero reference line (Fig. 6d), by means of a clamping circuit. The sync level then remains always at the same height, namely the preset Y position, even while the picture content varies.

The VF-RF Level Oscilloscope Type OHF is available at present in three models for the television transmitters in Bands I, III and IV. The matching elements for the RF tube are broadband in Bands I and III and do generally not require tuning. Should it be necessary to make more exacting demands for the input of these matching elements, above all with respect to return loss*, values of more than 26 db can easily be adjusted for with the aid of a Z-g Diagraph Type ZDU or Impulse Reflectometer Type ZUPI. These two models of the Type OHF have a coarse attenuator with 1-db steps for the presetting of the display height. This attenuator is accessible at the rear. The accurate fine adjustment of the display height on the raster is made directly

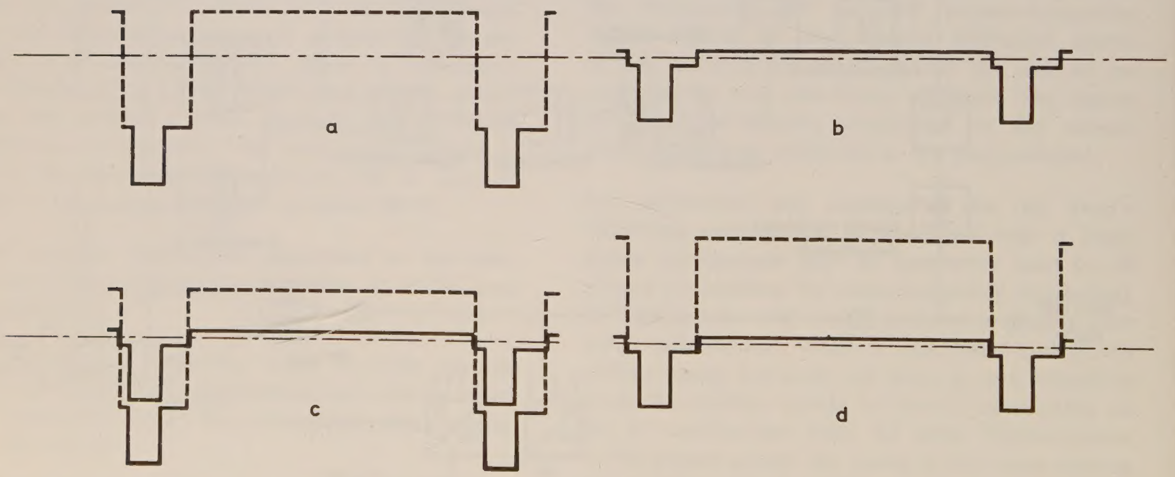


Fig. 6. a Line pattern with white picture content
b Line pattern with black picture content
c Line pattern without clamping
d Line pattern with level maintained by clamping circuit

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* For definition see Kurzinformation 2/61.

at the cathode-ray tube via a variable postacceleration voltage, i. e. without interfering with the signal once more. In the Band-IV model a guillotine attenuator is used for the adjustment of the display height by changing the attenuation of a line path. In the three models

Type OHF for TV Band I	BN 19131
Type OHF for TV Band III	BN 19133
Type OHF for TV Band IV	BN 19134

the RF tube requires an input of 10 v rms for black level, a standardized check-point voltage for the double-sideband demodulator of picture transmitters. Various graticules are available for the evaluation of the individual signals.

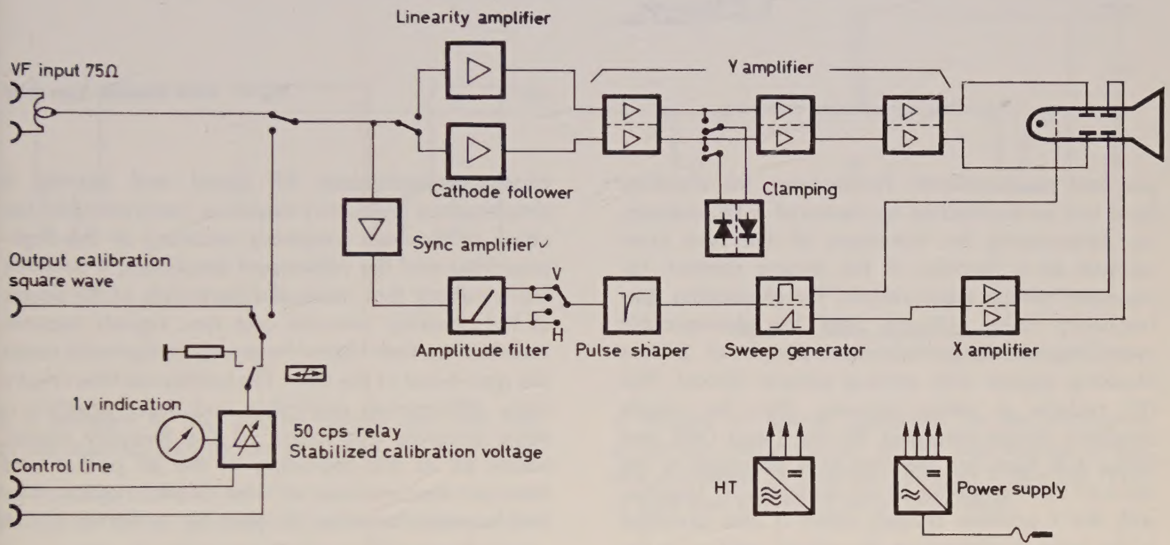


Fig. 7. Block diagram Type OVF

The VF Level Oscilloscope Type OVF (BN 1914)

The simple VF Level Oscilloscope Type OVF, specially designed for video-frequency monitoring, has been manufactured for some time. The video section and the time base present the same characteristics as that of the Type OHF. Only the RF cathode-ray tube with its matching elements and the associated X final stage has been omitted (Fig. 7). The Type OVF is thus suitable for all monitoring purposes in video-frequency engineering, for example in the studio, in radio links and repeater systems, on the picture transmitter and in the production of television receivers.

The instrument contains a transistor-stabilized calibration voltage for accurate level checking; a meter with a scale of 75 x 108 mm serves for indication. When the associated calibration button is actuated, a 50-cps relay forms square waves whose peak-to-peak values accurately correspond with the calibration voltage applied. These square waves are applied of necessity to the VF amplifier instead of the signal fed in. The calibration square wave is also available for external use. A pair of control lines is provided for remote switching; it has to be shorted when the calibration square wave is switched on.

The Precision Oscilloscope Type OMF (BN 1912)

Another instrument specially designed for the requirement of television measurements is the Precision Oscilloscope Type OMF. The block diagram is shown in Fig. 8.

Apart from the conventional blocks of a universal oscilloscope, such as DC coupled Y amplifier (bandwidth here up to 20 Mc), DC coupled time base instrument (range of 100 nsec/cm to 1 sec/cm), X amplifier with additional possibility of expansion of the time axis (factors 1, 5, 10 and 0.2 to 1) from the screen centre, a number of important additional features are provided.

A balanced delay line incorporated in the Y amplifier ensures that the slope triggering the sweep is visible on the screen. A voltage measuring facility providing reference lines on the screen ensures high accuracy of measurement by the coincidence method, the parallax error being eliminated. The built-in meter, class of accuracy 0.5, can be calibrated at 100% (the 100% point is at about ²/₃ of the scale length) and thus makes possible

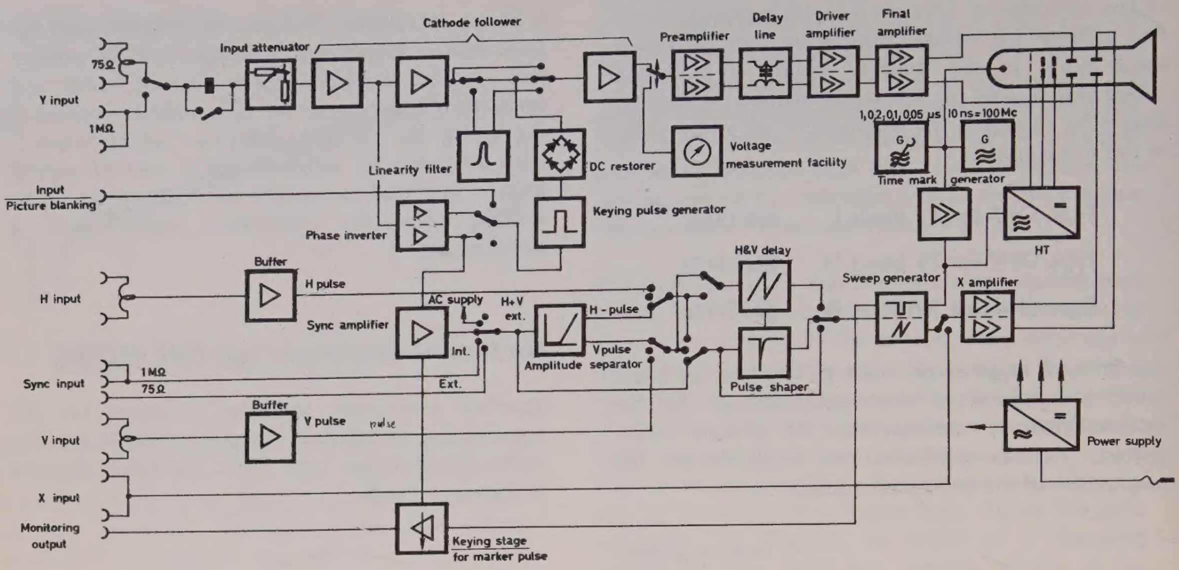
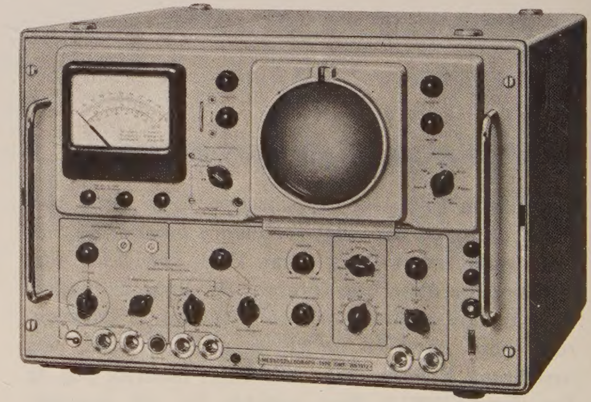


Fig. 8. Block diagram Type OMF

per cent measurements. Furthermore, the blanking level can be maintained by means of a DC restorer, for determining the variations of the sync components as a function of the picture content, for accurate voltage measurement, for eliminating low-frequency noise voltages, and for photographic recording of composite video signals or picture blanking signals with varying picture content. This DC restorer is more accurate than the simple clamping circuit described for the Types OHF and OVF; it is here for the first time provided in the input of the Y amplifier of an oscilloscope. Together with the Y position control, which is also provided in the input, it determines the signal position in the range of variation of the complete Y amplifier and not only, as was usual up to now, in the final stages. A clamping circuit in the final stages ensures that the pattern of a video-frequency signal of varying picture content is fixed at a given level. However, for driving the stages ahead of the clamping circuit a double linear range of variation is necessary, as can be seen from Figs. 9a and 9b. A clamping circuit in the input of the Y amplifier eliminates these drawbacks, which are easily caused by a one-sided signal position in the range of variation of the amplifier and falsify the voltage components of the pattern.

A high-pass filter, as described for the VF-RF Level Oscilloscope Type OHF, for measuring the variations in slope is used in a more elaborate form in the Type OMF. It covers 6 positions of the Y selector switch. While in the Types OHF and OVF the filter circuit has a high-pass characteristic, the OMF uses an additional filter section comprised of 5 band-pass filters with the centre frequencies 1, 2, 3, 4 and 5 Mc. Although the simple high-pass filter circuit has the advantage of a continuous variation of the superimposed RF signal and permits a simultaneous frequency-response measurement because of the high frequency accuracy of the high-pass filter and the subsequent amplifiers, it presents the drawback that residual differentials of the slopes of the blanking intervals and sync signals become visible, since their higher frequency components reach the pass-band of the filter. The band-pass filters make these differentials negligible and make possible a more accurate evaluation of the linearity signal, above all at the beginning of the RF packet and thus in the vicinity of the black region. The simultaneous increase in gain by a factor of 10 ensures that an RF superposition of 10% gives without correction the display height originally adjusted for. All these measurements may, of course, also be made with high impedance and



Precision Oscilloscope Type OMF

via a probe without the need of using separate filter groups.

The sweep synchronization facilities are also very versatile. The latest model includes a H delay in addition to the earlier V delay, a facility which makes visible on the screen one or a few lines of a picture period. This H delay permits the point where the sweep starts to be shifted to any point within one line so that for the investigated detail of the picture signal on the line the maximum possible sweep expansion of the oscillosope can be utilized.

The details of the video-frequency signal displayed on the screen may be marked in a channel derived from the Y amplifier and applied via the monitoring output to a television receiver (monitor). Thus it is possible to find picture details with the help of the monitor and to evaluate them on the screen.

All specific possibilities of television measurements have been taken account of in the selection of the sync inputs. A cable input with a 75-Ω termination, a twin socket for bridging or termination with any impedance, and the synchronization of the measurement procedure may be selected either via the amplitude filter with separation into V and H pulses or directly for synchronization to the picture content. AC supply synchronization for the investigation of AC supply coupled phenomena or synchronization by the V and H pulses bridged in through 75-Ω filter outputs is provided. The polarity is freely selectable for each input.

The measurement of noise voltages met with considerable difficulties up to now. The provision of the DC amplifier and the Y-position control in the input of the Type OMF together with a gain increase by a factor of 10 gives a magnification of the signal, for example from 50 mm display height to an equivalent display height of 500 mm. Every portion of the expanded signal can be shifted with the Y position control into the display range of the cathode-ray tube. Noise components of the order of − 60 db are thus visible on the screen. This measurement facility up to now offers the only possibility of measuring such small components with the amplifier fully driven. It is thus easily possible to measure the difference of the noise voltage of the sync component from the noise voltage of the picture component.

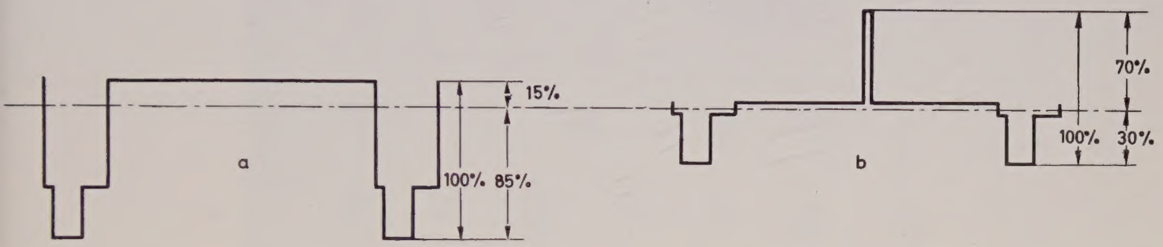


**Fig. 9. a White picture signal.
b Black picture signal with needle pulse.**

A number of special graticules for the evaluation of certain measurements on the oscilloscope screen are available. A Cathode-Follower Probe BN 19128 is now also available as an accessory.

The Precision Oscilloscope Type OMF constitues an important unit of our Picture Transmitter Test Assembly and of the small Video Test Assembly. It provides for quantitative measurement of test signals before and after passing through the test item.

Summarizing we may say that an essential part of the measurements on television transmitters can be made using only our oscilloscopes.

Type **OMF**

PRECISION OSCILLOSCOPE

DC to 20 MC

Directly coupled input to the horizontal and vertical amplifiers

Highly sensitive vertical amplifier, maximum sensitivity 4 mv/cm

Wide range of sweep times: 1 sec/cm down to 0.1 µsec/cm; repetition frequency up to 750 kc

Jitter-free display through regulated supply voltages

A voltage measuring arrangement of high accuracy for absolute and relative measurements

Versatile connection possibilities through paralleled inputs and bridging-type inputs

Built-in time-mark generator

Especially designed for television engineering

Keyed d-c restorer for maintaining the blanking level; provision for line selection with output for video monitor; Y magnifier for measuring hum and noise and for amplifier-linearity measurements; internal synchronization by V or H pulses derived from composite signals; external synchronization by V or H pulses derived from combined or separate V and H synchronization signals.

HDE & SCHWARZ · MÜNCHEN

Data sheet
191 200

Uses

The Precision Oscilloscope Type OMF has the characteristics of an all-purpose oscilloscope which through special design meets the requirements of television engineering. The field of application is therefore quite large; for example, the Type OMF is an indispensable unit of a television test assembly.

Vertical Deflection System. The large bandwidth of the vertical amplifier permits error-free investigation of rise times as short as $2 \cdot 10^{-8}$ sec. Fast rising waveforms, the leading edges of which are used to trigger the sweep and therefore would not normally be seen, are made visible by means of a built-in delay network. In order to be able to determine the exact magnitude of the pattern, two horizontal reference lines can be displayed. Their spacing is continuously adjustable, and the corresponding voltage is directly read from a large panel meter. In addition, the scale of the panel meter is calibrated in terms of per cent for use in comparison measurements. 10-x magnification of the vertical scale takes place when the Type OMF is switched for hum and noise measurements. The vertical positioning control has such a large range that every point on a one-metre equivalent display height can be covered with the full vertical magnification.

A probe with ¼ the input capacitance of the vertical amplifier and ten times attenuation is supplied with the Type OMF as standard equipment. In addition, a cathode-follower probe is supplied that also has a low input capacitance, its advantage being low attenuation of the input signal.

Horizontal Deflection System. The high-quality, directly-coupled sweep generator provides for a wide range of sweep times. For example, it is possible to write one cycle of a 1-mc signal over the entire sweep length. Triggering is possible even for the fastest sweep. The sweep generator produces a sawtooth voltage whose flyback time is only ¼ the sweep time even in the fastest sweep range. The sawtooth voltage can be taken from a separate output. The waiting time between the end of the flyback and readiness for triggering the next sweep is extremely short and practically negligible. A sweep magnifier permits the sweep to be amplified up to ten times, while continuous compression is possible down to one fifth.

The sweep generator can be synchronized up to 10 mc by locking in, or triggered by any waveform with a frequency up to 3 mc suitably shaped by an internal pulse former. Sweep-synchronized time markers simplify the determination of frequencies, rise times, etc. The time markers appear in the display by breaking the trace into equal light and dark intervals; they can be obtained from either within the set or externally from a-c voltages of defined frequencies.

DC Restoration. The built-in keyed d-c restorer maintains the blanking level of a composite signal at a fixed value. Thus, for example, it is possible to investigate amplitude changes in the synchronizing pulses as a function of the video signal, to eliminate low-frequency disturbances, or to photograph composite signals with varying video content. The necessary keying pulses for the d-c restorer are independent of the position of the sync selector switch of the Type OMF since these pulses are derived directly from the incoming signal to be measured.

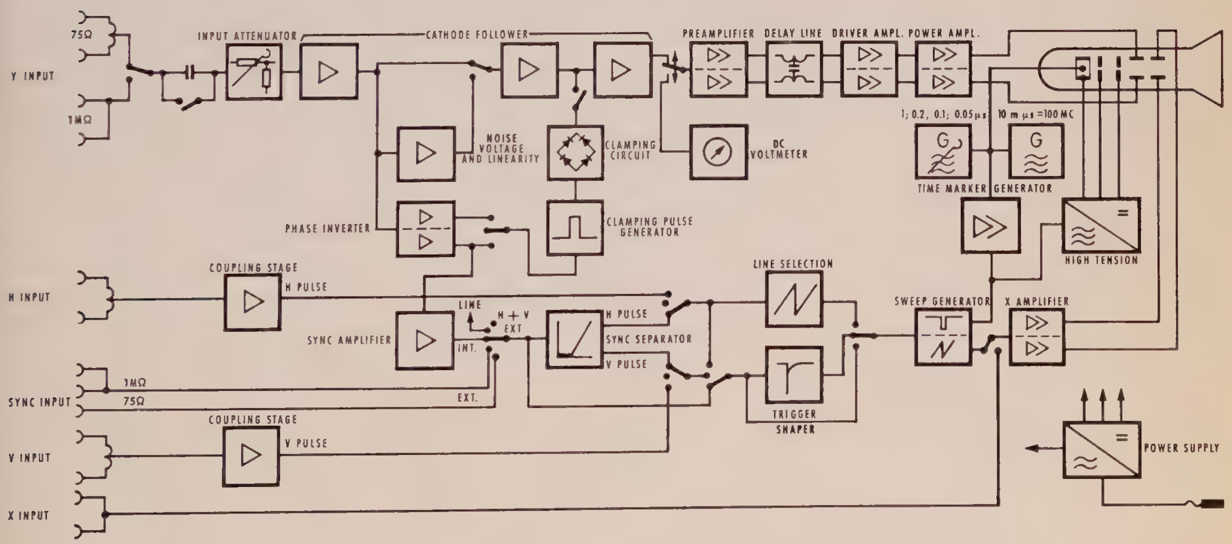
Amplifier-linearity Measurements. In the switch position "linearity", a high-pass filter is connected after the first input stage; this makes possible transconductance linearity measurements by the SMPTE intermodulation method. At the same time, the vertical gain is raised by a factor of 10. In this manner, a high-frequency component with an amplitude of 10 % of the composite signal provides a display height of 50 mm for exact evaluation without any further adjustment.

Hum and Noise Measurements. Easy evaluation of hum and noise voltages superimposed on television signals is made possible by the vertical magnification, which has already been mentioned.

Synchronization. Special synchronization circuits make the Precision Oscilloscope Type OMF usable for every type of measurement problem encountered in television engineering. The input signal can either be directly used or fed through an amplitude filter separating the V and H pulses for the synchronization. Investigations on wave patterns that are connected with the a-c supply can be made by synchronizing the sweep generator with the local supply frequency. Synchronization signals from external sources can be applied to the set via different inputs. This facilitates the operation of the equipment and enables matching to a given signal source.

Line Selection. A line selector permits display of one or more lines of the switch-selected field. The synchronization is selected line by line, either continuously or in steps. The composite signal can be taken from the Type OMF for further observation on a picture monitor. The selected lines appear brighter than the remaining lines, due to an additional unblanking pulse applied to the picture monitor.

The Precision Oscilloscope Type OMF is fundamentally suited for problems in pulse, radar and control engineering. Moreover, its characteristic as a special-purpose television test oscilloscope makes for utilization in TV studio, TV link and TV transmitter engineering; e.g., it forms part of our Picture Transmitter Test Assembly.



Highly simplified block diagram of the Precision Oscilloscope Type OMF

Description

Circuitry. The vertical amplifier, which contains a balanced delay network, has 8 stages operating in push-pull.

A multistage cathode-follower buffer amplifier lies ahead of the push-pull amplifier, thus making possible the connection of the additional internal facilities. The Y signal is taken after the first cathode-follower stage for the internal synchronization. In addition, the signal is fed through a phase-inverter for driving a pulse generator which, in turn, keys a clamp-type d-c restorer connected to the last cathode-follower stage of the buffer amplifier. This circuit maintains the blanking level of a composite signal at a fixed value. The facility for hum, noise and linearity measurements, which is switched into circuit after the first cathode-follower stage, is comprised of a high-pass filter and an amplifier raising the total vertical gain by a factor of 10. A polarized relay, which for voltage measurements keys the reference lines into the vertical amplifier at the supply frequency, follows the last stage of the buffer amplifier.

The synchronization signals are sent through an amplifier which can be connected to the sawtooth generator either directly or via a pulse shaper. Moreover, an amplitude filter for separating the V and H pulses and a line selector for composite signals are included in the synchronization channel especially for measurements in TV engineering. The sawtooth voltage of the sweep generator is fed to the horizontal amplifier which operates in push-pull.

In addition, the sweep generator delivers a square-wave voltage which, during the sweep or rise of the sawtooth voltage, unblanks the cathode-ray tube. At the same time, this square-wave voltage drives the time-mark generators and thus ensures their sweep-synchronized operation.

The various d-c power supply voltages are individually regulated, which gives the set a high stability against a-c supply voltage variations.

Mechanical Construction. Compared with its many measuring possibilities, the Precision Oscilloscope Type OMF has relatively small dimensions. This has been realized, in spite of the large number of valves and special facilities for TV engineering, through effective ventilation and space-saving construction of the entire oscilloscope. The screen of the cathode-ray tube is shaded with a bezel blackened on the inside and used to hold the interchangeable graticules. Since the graticules are placed close to the screen, parallax errors in reading and evaluating the oscillogram are almost impossible. An arrangement depicted on the last page of this data sheet is provided to facilitate the photographing of the pattern. An illuminated label makes it possible to photograph a handwritten note simultaneously with the oscillogram. Such a careful designation of each photograph simplifies later evaluation considerably.

All of the control knobs are arranged on the front panel according to their function and are clearly marked with pertinent labels. The high-impedance double inputs are located on the front panel and are arranged near the associated control knobs. The sockets for low-impedance cable connections or bridging inputs are located at the rear of the set.

The Precision Oscilloscope Type OMF is supplied in a separate steel cabinet for use as a single instrument (BN 1912), or as a rack-mounting unit built to German standard DIN 41490 for mounting in a cabinet rack (BN 1912 D).

Specifications

▶ Order Number BN 1912

Cathode-ray Tube	DG 13–54
Screen diameter	13 cm
Usable beam deflection	6.5 cm vertical 10.5 cm horizontal
Phosphorescence	12 millisec (average value)
Anode voltage	3 kv
Total accelerating voltage	6 kv
Graticule illumination	controllable, white
Vertical Amplifier	d-c coupled
Deflection factor	40 mv_{pp}/cm
Without amplifier	20 V_{pp}/cm
Frequency range	d-c to 20 mc in position "d-c voltage" 0.1 cps to 20 mc in position "a-c voltade"
Response at 5 mc	down less than 0.3 db
Response at 10 mc	down less than 1.5 db
Response at 20 mc	down less than 3.0 db
Rise time	18 millimicrosec
Overshoot	less than 2 %
Tilt or sag	less than 0.5 %
Signal delay	0.2 µsec by built-in delay network
Attenuator	1:100
in steps	1:1/3/10/30/100
continuous between steps	more than 1:3
Input impedances	high and low
Sockets for probe and probe attenuator*	1 MΩ in shunt with 30 µµf
Bridging-type inputs**	75 Ω, reflected wave at least 34 db below incident wave for frequencies up to 10 mc
Non-linearity with a picture height of 5 cm	
without d-c restoration	±1%, maximum
with d-c restoration	dependency of sync level upon content of video signal is less than 1%
Maximum useful display height	6 cm
D-c restoration	switch-selected keyed d-c restorer
Magnification (overdriving capability of the amplifier)	10 times a display height of 5 cm
Non-linearity	±1%
Facility for linearity measurements	usable for SMPTE intermodulation method
Frequency range	0.8 mc to 8 mc
Separation of the RF signal component	by means of a high-pass filter
Vertical gain	10 times
Inherent error	below 0.3 %

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* Connections on front panel: unbalanced, two parallel-connected 13-mm sockets DIN 47283 (DIN 47284, if desired).

** Connections at the rear: unbalanced, 13-mm sockets DIN 47283 (DIN 47284, if desired) for cabinet model, 9-mm connector for cable for rack-mounting unit.

Facility for hum and noise measurements	has a large control range for vertical positioning
Frequency range	1 cps to 8 mc
Response at 5 mc	down 1 db
Response at 8 mc	down 3 db
Deflection factor	4 mv$_{pp}$/cm
Range of vertical positioning control	more than 10 times the display height
Facility for voltage measurements	for absolute and relative measurements
Reference lines	continuously variable d-c voltage applied at supply frequency
Voltage range	0 to 1/3/10/30/100 v$_{pp}$
Voltage indication	on panel meter; accuracy of 0.5% f.s.d.
Scale calibration	0 to 1 v, 0 to 3 v, 0 to 140%
Relative measurements	with 0.2 v input voltage still adjustable to 100%
Calibration voltage source	1 v$_{pp}$ (square-wave at supply frequency)
Accuracy	±1%
Source impedance	less than 5 Ω
Optimum load impedance	75 Ω
Attenuator probe	for connection to the vertical amplifier (length of cable, 1 metre)
Input impedance	10 MΩ in shunt with 8 μμf
Attenuation	10 : 1
Frequency range	d-c to 20 mc
Unblanking Circuits	
Sweep unblanked	by means of d-c coupled unblanking voltage
Output for unblanking voltage	d-c coupled
Output voltage	approx. 10 v$_{pp}$
Output impedance	approx. 150 Ω
Load impedance	greater than 10 kΩ
Time markers, sweep-synchronized	10/50/100/200/1000 millimicrosec
External marker input	a-c coupled
Voltage requirement	approx. 15 v$_{pp}$
Input impedance	1 MΩ in shunt with approx. 20 μμf
Horizontal Amplifier	d-c coupled
Deflection factor	less than 400 mv$_{pp}$/cm
Frequency range	d-c to 1 mc
Input impedance*	1 MΩ
Normal sweep length	10 cm
Magnification (overdriving capability of the amplifier)	10 times the normal sweep length of 10 cm
Sweep	continuously variable from free-running to triggered
Frequency range (free-running sweep)	0.1 cps to 750 kc
Frequency range (triggered sweep)	up to 750 kc

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* Connections on front panel: unbalanced, two parallel-connected 13-mm sockets DIN 47283 (DIN 47284, if desired).

Sweep times	1 sec/cm to 0.1 µsec/cm
in steps	$1/10^{-1}/10^{-2}/10^{-3}/10^{-4}/10^{-5}/10^{-6}$ sec/cm
continuous between steps	1.1 to 0.1 times
Accuracy	±3 % (control at r.h. stop)
Non-linearity	less than 10 % with 10 cm display width and between 1 sec/cm to 1 µsec/cm
Sweep length	10 cm, without magnification
Sweep magnification referred to 10 cm sweep length	
in steps	1/5/10 times
continuously variable	0.2 to 1 times
Output of the sawtooth voltage	d-c coupled
Output voltage	approx. 30 vpp
Output impedance	approx. 150 Ω
Permissible load impedance	greater than 10 kΩ
Synchronization	lock-in type or triggered
Synchronization range	1 cps to 10 mc
Triggering range	1 cps to 3 mc
Threshold, external	1 vpp
Threshold, internal	2 cm display height
Polarity of the sync signal	switch-selected
Synchronization threshold	continuously variable
Internal and external synchronization with sync or composite signals	separation into H and V pulses possible
Line selector	synchronization by means of preselected H pulses or continuously
Output for picture monitor	Y-signal with a marker impulse for the selected lines
Output voltage	approx. 1 vpp for 5 cm display height
Output impedance	approx. 150 Ω
Field selection	by switch
Inputs	for sync signals
H pulses (bridging type input)**	75 Ω reflected wave at least 34 db below incident wave for frequencies up to 10 mc
V pulses (bridging type input)**	75 Ω reflected wave at least 34 db below incident wave for frequencies up to 10 mc
Sync input, high-impedance*	1 MΩ in shunt with max. 35 µµf
Sync input, low-impedance**	75 Ω ±1%
Permissible external sync voltage	1 to 30 vpp
Power Supply	115/125/220/235 v $^{+10}_{-15}$ %, 47 to 63 cps (660 va)
Dimensions	540 x 370 x 455 mm mounted in steel cabinet with front cover
Weight	50 kg as rack-mounting unit, 64 kg mounted in steel cabinet

Valve Complement: 1 x DG 13-54, 8 x E 80 L, 1 x E 81 L, 25 x E 88 CC, 3 x EAA 91, 2 x ECF 80, 11 x EF 800, 12 x EL 86, 3 x PCF 80, 2 x E 180 F, 3 x ECC 81, 1 x QQE 03/12, 2 x 6463, 2 x 85 A 2

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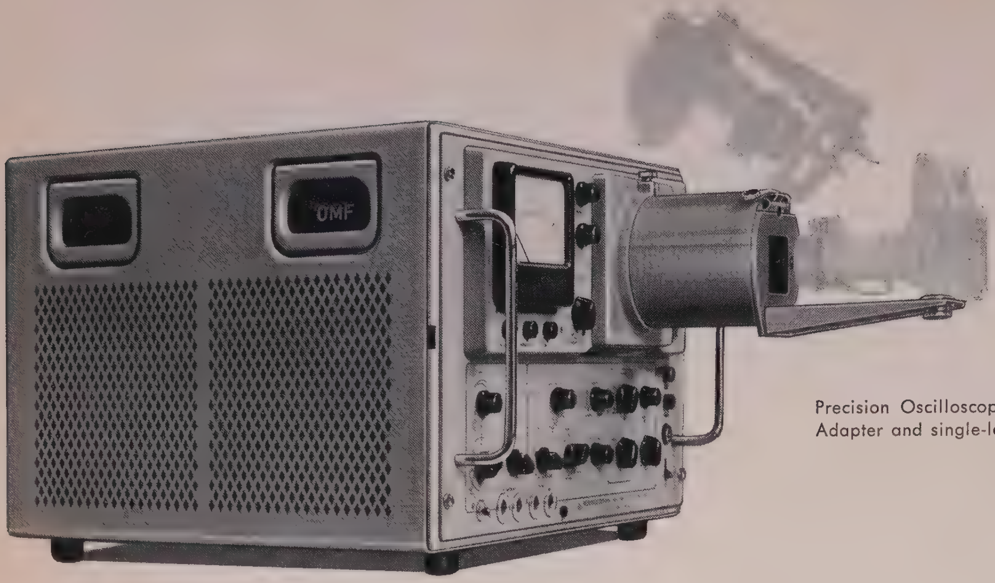
* Connections on front panel: unbalanced, two parallel-connected 13-mm sockets DIN 47283 (DIN 47284, if desired).

** Connections at the rear: unbalanced, 13-mm sockets DIN 47283 (DIN 47284, if desired) for cabinet model, 9-mm connector for cable for rack-mounting unit.

PRECISION OSCILLOSCOPE OMF



Precision Oscilloscope Type OMF with Camera Adapter and single-lens reflex camera

Accessories		**► Order Numbers**
Attenuator Probe		BN 1912-19*
Cathode-follower Probe (attenuation 1: 0.9, input impedance 10 MΩ in shunt with 5 µµf, range d-c to 15 mc)		BN 19128
Graticules		
Rectangular co-ordinates		BN 1912-14.11*
Level standardization for video	according to German standard specifications for picture transmitters	BN 19121
Level standardization for RF		BN 19122
Transient response standardization		BN 19123
Camera Adapter For a single-lens reflex camera (for example: Contaflex, Praktica, Praktina, Exakta Varex, Retina Reflex)		BN 19120

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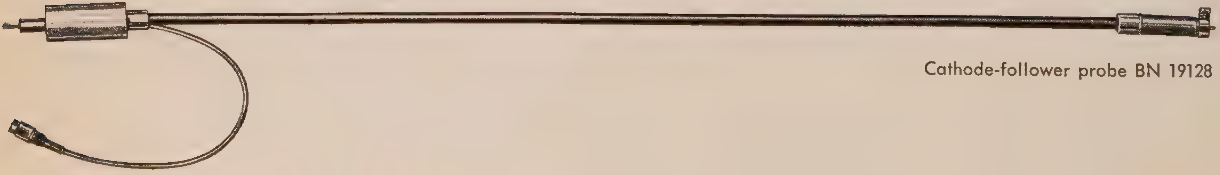
* The parts designated with the asterisk as well as a 50 cm long patch cord with banana plugs are included in the order number BN 1912 for the Precision Oscilloscope

Attenuator probe BN 1912-19



Cathode-follower probe BN 19128

We reserve the right to make any departures from this specification, especially those considered desirable for reasons of improved design.

R & S Instruments for AF and RF Measurements

Selective Voltmeters and Measuring Receivers

Within the general survey given in the Kurzinformation on the R & S measuring instruments and communications equipments, the compilation of R & S voltage measuring instruments was taken up in No. 3. The flat-response valve voltmeters with and without preamplification were compared with respect to performance and described as to voltage and frequency ranges. The measurement ranges covered by our line of selective voltmeters was indicated. Almost all frequency regions can be attained with these instruments without sacrifice in voltage sensitivity, since the receiver bandwidth usually is small enough so that the noise voltages do not reach the order of magnitude normally found in flat-response valve voltmeters.

The simplest instruments are the tunable indicating amplifiers with uncalibrated indicator section, which are suitable as relative voltmeters and null indicators and are widely used in laboratories because of their versatility and low price. The selective voltmeters are frequently called test receivers. In most cases they use the heterodyne method and have facilities for amplitude demodulation. In conjunction with calibrated antennae these receivers can be used as field-strength meters. Some of the field-strength meters are also suitable as radio monitoring and radio receivers, almost all radio receivers built by Rohde & Schwarz can be used for field-strength measurements in conjunction with a standardizing oscillator.

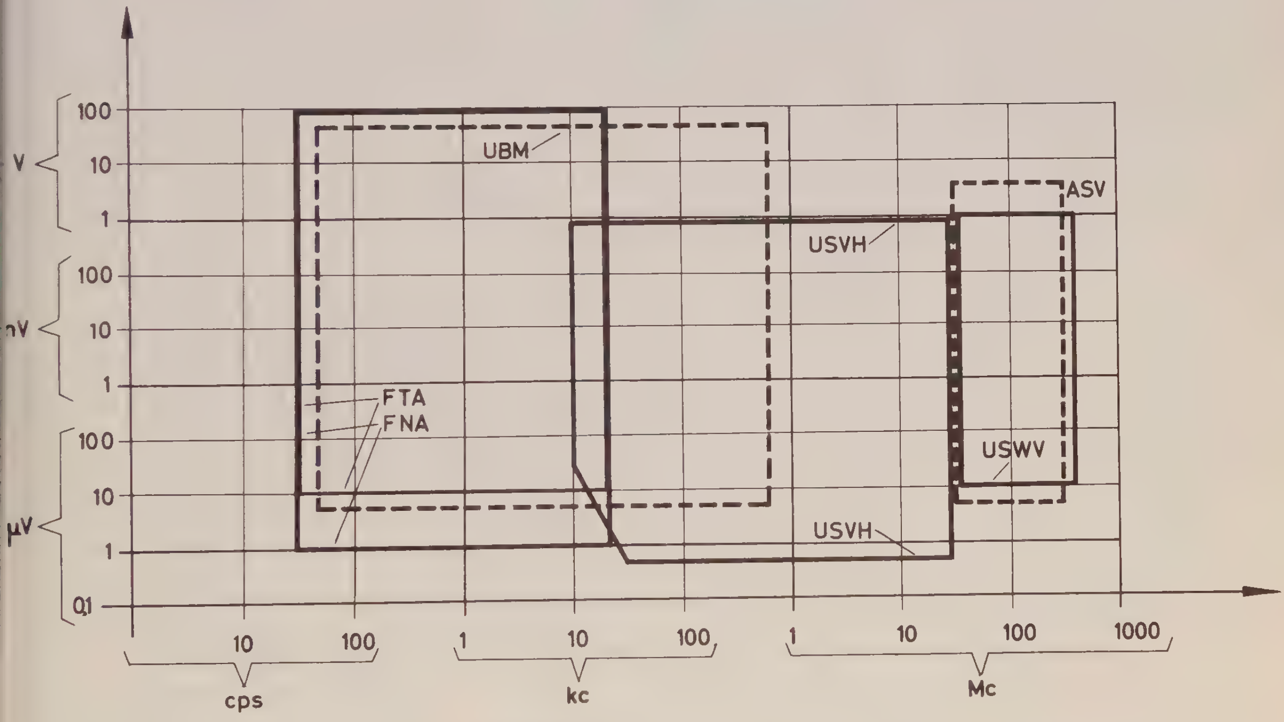


Fig. 1. Frequency and voltage ranges of the selective valve voltmeters Types FTA, FNA, USVH, USWV and indicating amplifiers Type UBN and ASV.

All lower voltage limits here specified refer to 1/10 of full-scale deflection of the meter in the lowest measurement range. The voltage value of 10 db above the noise level is given in the graphs as the lower voltage limit. If different bandwidths are selectable, the smallest bandwidth is assumed. Where AM and FM demodulation are selectable, the noise voltage is specified for AM demodulation at 30 % modulation depth and 1000 cps modulation frequency.

A 2a. Tunable Indicating Amplifiers

The **Tunable Indicating Amplifier Type UBM** BN 12121/2 covers the frequency range 45 cps to 600 kc in 5 bands. Variable feedback permits the gain to be varied between 10,000 and 300,000 and thus the bandwidth between 10% and 0.3%. At 2% bandwidth, voltages from 5 µv to 50 v are measurable (Fig. 1). The noise is then about 2 µv, the gain 50,000. The indicating amplifier can be switched over to flat-response operation. The gain then decreases down to 3000, and the set is 20 times less sensitive. The voltage indication is not calibrated. The Type UBM is suitable for audio- and carrier-frequency measurements in laboratories, test departments and monitoring; because of its high sensitivity and selectivity it is used to advantage as a null indicator.

The **Tunable VHF Amplifier Type ASV** BN 1372 has a gain of about 40 db and covers the frequency range 30 to 300 Mc in one band. The output voltmeter is calibrated in two ranges, 50 to 250 mv and 0.5 to 5 v, but the gain is not completely constant over the frequency range. The specified input voltage of 0.5 mv to 3 v is therefore to be considered as an approximate value (Fig. 1). The noise figure is 40 kT_0 (16 db). The relative bandwidth of 1% and source impedance of 60 Ω give a noise voltage of 3.4 µv at 300 Mc, which decreases down to one third at 30 Mc. The special advantage of the Type ASV lies in its versatile uses as amplifier, buffer amplifier, limiting amplifier, null indicator, straight-through receiver, coarse frequency meter, VHF generator, AF generator, AM demodulator, frequency multiplier and AM modulator; special facilities permit the modulation of the amplified signal by means of a built-in 1000-cps AF oscillator. External modulation is also possible. Due to a switch-selected feedback circuit the Type ASV can be used as a signal generator with an output voltage adjustable between 30 mv and 5 v. The possibility of modulation has been mentioned before. In conjunction with a suitable mixer & harmonic generator the Type ASV operates as a frequency converter and multiplier.

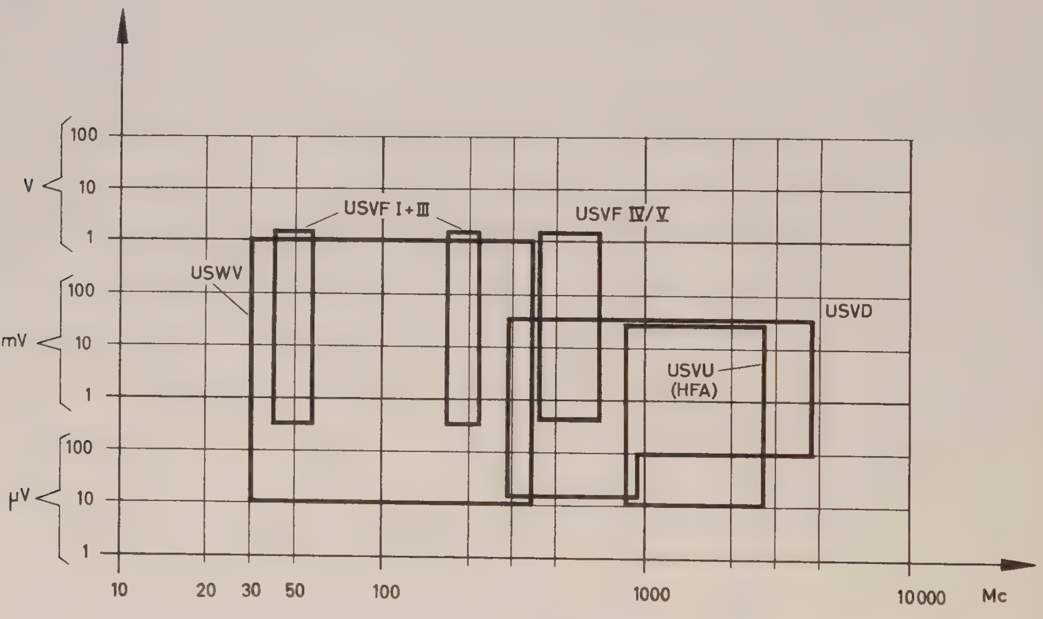


Fig. 2. Frequency and voltage ranges of the selective valve voltmeters Types USWV, USVF, USVD, USVU.

A 2b. Selective Valve Voltmeters with Absolute Voltage Calibration

Type F . . . BN 4830 . . .
Type US . . . BN 152 . . .

The **AF Wave Analyzer Type FTA** BN 48302 and the **Audio-Frequency Spectrograph Type FNA** BN 48301 are available for the audio-frequency range. With these instruments, any waveforms can be separated into their spectrum components. Apart from selectivity and sensitivity, both instruments have similar electrical data. They operate according to the heterodyne principle, cover the range of 30 cps to 3 kc in one band and can be adjusted for bandwidths of 6 cps (10 cps, respectively) and 200 cps. The AF Wave Analyzer Type FTA is the simpler, hand-driven set (an external driving motor for the frequency sweep can nevertheless be flange-connected). The Audio-Frequency Spectrograph Type FNA is a fully automatic measuring instrument with automatic frequency sweep and a built-in recorder for recording the frequency components. The voltage range of the Type FNA is 1 µv to 100 v with a noise voltage of approx. 0.2 µv in the narrow-band position. Below 2 kc, the noise increases and is about 1 µv at 30 cps, since the flicker effect here becomes rather strong. The lower voltage limit of the Type FTA is at 10 µv (signal-to-noise ratio better than 12 db). In conjunction with a specially designed synchronous oscillator the Types FTA and FNA offer a great variety of uses in selective frequency measurements on four-terminal networks.

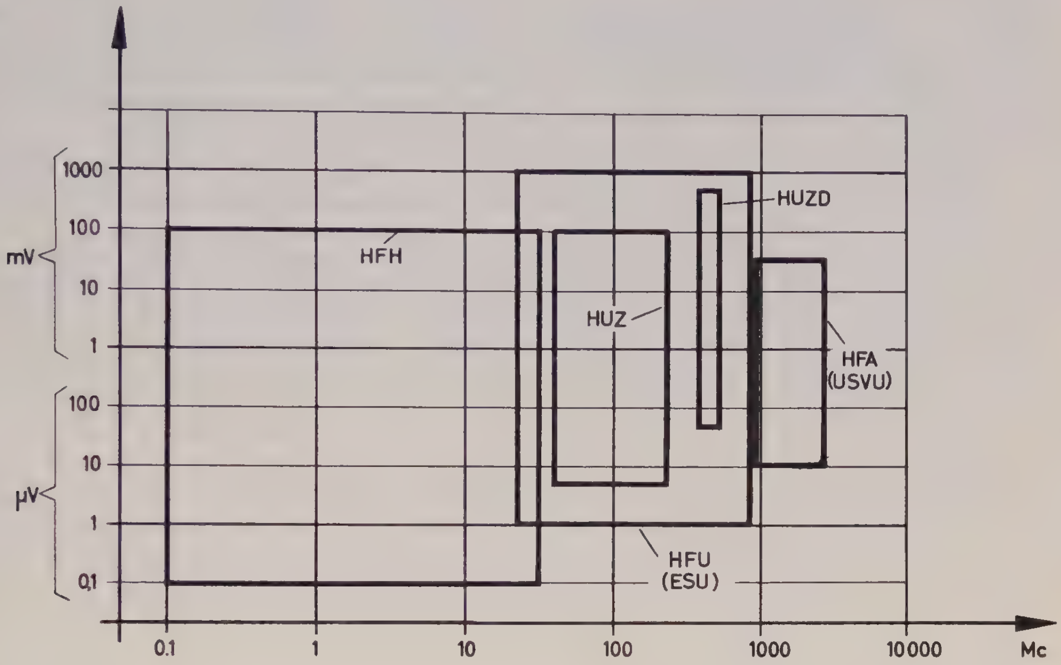


Fig. 3. Frequency and voltage ranges of the field-strength meters Types HFH, HFU (ESU), HFA (USVU), HUZ, HUZD.

The next higher frequency range, 10 kc to 30 Mc, is covered in 6 bands by the **Selective Microvoltmeter Type USVH** BN 1521. Voltages from 0.2 µv (1/5 of full-scale deflection) to 1 v are measureable above 30 kc (Fig. 1). The bandwidth can be adjusted for 500 cps and 5 kc. The noise voltage is 0.15 µv in narrow-band operation. The input impedances are 50/60/70/75/150 Ω/500 kΩ switch-selected. Selective attenuation and frequency-response measurements up to about 130 db on any four-terminal networks and selective frequency-response measurements on amplifiers and filters in the pass-band are examples of the great number of possible applications. The small inherent distortion (as low as 60 db) permits the measurement of RF distortion in signal generators of the long-, medium- and short-wave ranges. Measurements of modulation depth at carrier frequencies from 10 kc to 30 Mc and modulation frequencies above 1 kc are possible. The modulation distortion and the adjacent-channel attenuation in carrier-frequency systems can be determined. Attenuators of signal generators can be checked with an accuracy of ±2% down to 10 µv and the conversion transconductance can be measured directly at the anode of a mixer. The leakage of shields and RF chokes is measurable since fractions of a microvolt are detectable.

The **Selective VHF-UHF Voltmeters Type USVF** for the television Bands I and II (BN 1528) and IV and V (BN 15285) are specially designed for television measurements. A coarse adjustment is provided for channel selection. The continuous tuning range for each channel at both sides of the picture carrier frequency is ± 8 Mc. The instruments are superheterodyne receivers with respectively two and three intermediate frequencies with a bandwidth of 8 kc. Voltages from 0.2 to 1.5 v (noise voltage ≤ 0.1 mv) or 0.3 mv to 1.5 v for the Band IV/V sets can be measured (Fig. 2). The voltage sensitivity of both instruments has been reduced in the interest of a very constant input impedance of 50 Ω or 60 Ω. These instruments are used for the measurement of the amplitude ratio of picture and sound carrier, for point-by-point measurement of the spectral energy distribution within the sidebands of the picture carrier, for measurement of the modulation depth and modulation distortion, linearity measurement, measurement of adjacent-channel interference, etc. A special concept is embodied in the **Selektomat**

Type USWV BN 15221, an automatic selective VHF valve voltmeter. Its frequency range continues that of the Type USVH and covers 30 to 400 Mc in 7 bands. Voltage measurements are possible from 10 µv to 1 v with a signal-to-noise ratio better than 10 db (Figs. 1 and 2). The Selektomat incorporates an electronically tuned local oscillator. An automatic scanning circuit covers the entire VHF range and locks on the strongest signal or tracks a weaker signal once selected by manual tuning when this signal changes in frequency.

The received frequency and the amplitude are indicated on meters. Since the instrument follows, almost without inertia, the variations of the test frequency, it is also usable as preamplifier for sweep signal generators (e. g. for the POLYSKOP I Type SWOB). The maximum tracking speed is greater than 10 Mc/ms. The Selektomat delivers two output voltages, namely the measured value and a variable calibrated reference value (reference line). The automatic frequency tracking can be switched off.

The Selektomat is useful for frequency-response measurements on two- and four-terminal networks of all kinds and for measuring the far-off selectivity of filters and amplifiers. In conjunction with a reflectometer it measures the input reflection of four-terminal networks and antennae.

The next higher frequency range, 280 to 940 Mc (4600 Mc), is covered by the UHF Test Receiver Type USVD* BN 1523. The voltage range is 12 µv ($^1/_3$ of full-scale deflection) to 30 mv with a signal-to-noise ratio of 10 db. When mixing with harmonics of the oscillator frequency up to 4.6 Gc is used, the measurement range is 100 µv to 30 mv (Fig. 2). The set is suitable for relative measurements only; a calibrated attenuator in the IF amplifier provides for high accuracy. The Type USVD has an untuned crystal diode mixer in its input. This stage is voltage linear up to about 50 mv; the upper voltage limit of the set is therefore at 30 mv. One IF output and three AF outputs are provided.

The **UHF Test Receiver Type USVU** BN 1524 provides for voltage measurements from 10 µv to 30 mv with a signal-to-noise ratio of 10 db in the frequency range 0.9 to 2.7 Gc (2 bands). While for absolute voltage measurements the accuracy is about ± 2 db, the built-in calibrated attenuator permits relative voltage measurements with an accuracy of ± 0.1 db. The constant inherent noise power of the instrument is used for absolute calibration. The input circuit is the same as in the Type USVD. Outputs for IF, AF and connection of an oscilloscope are provided, as well as an output for connection of a recorder. The tuning of the Type USVU is accomplished by a servomotor, the centre-frequency error being kept within ± 30 kc. In conjunction with a calibrated aerial, with the **UHF Parabolic Antenna** Type HA 262, specially designed for this purpose, and with the **Switchable UHF Bandpass Filter Type PBA,** the Type USVD is suitable for field-strength measurements. This **UHF Field-Strength Measuring Equipment** carries the designation **Type HFA** BN 15003.

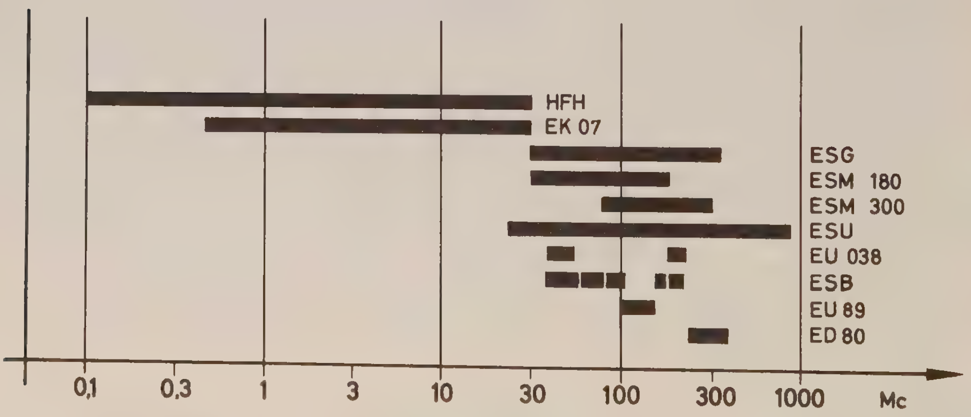


Fig. 4. Frequency ranges of the radio receivers Type HFH, UE 12, EK 07, ESG, ESM 180, ESM 300, ESU, EU 038, ESB, NE 1/2, and ED 80.

A 2c. Field-Strength Meters

Type E . . ., H . . ., BN 150 . . .

In contrast with the Type USVU, which is a valve voltmeter also suitable for field-strength measurements, the **Field-Strength Meter Type HFH** BN 15001 is specially designed for field-strength measurements. It covers the long-, medium- and short-wave range from 0.1 to 30 Mc in 10 bands and is equipped with switch-selected AFC, switch-selected bandwidth of 200/1000/8000 cps, tracking standardizing oscillator, AM demodulator, and BFO. Three loop antennae and a separate rod antenna are provided. Field strengths between 1 µv/m and 1 v/m can be measured. No correction curves are necessary. The first and the second IF are brought out for a great variety of measurements; an AF and a recorder output are provided. The set is suitable for both AC supply and battery operation. Used as a valve voltmeter, it measures voltages from 0.1 µv to 0.1 v with a minimum signal-to-noise ratio of 10 db. The Type HFH is also usable as a monitoring receiver.

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* See Kurzinformation 2/61.

Two portable, battery-operated instruments are: The **VHF Field-Strength Indicator Type HUZ** BN 15012/2, covering the frequency range 47 to 225 Mc in one band and the voltage range 5 µv to 100 mv, with a frequency-dependent correction factor k = field strength/input voltage of 1 to 8; and the **UHF Field-Strength Indicator Type HUZD** BN 15014, covering the frequency range 430 to 610 Mc in one band and the voltage range 50 µv to 500 mv, with a frequency-dependent correction factor k = 6 to 17.

The gap between 30 and 900 Mc is filled by the **VHF-UHF Test Receiver Type ESU** BN 150021; with three interchangeable RF units this set covers the frequency range 25 to 900 Mc (Figs. 3 and 4). This set is a complete radio and monitoring receiver (BFO, AM-FM demodulator). In conjunction with a broadband dipole (25 to 80 Mc, k ≈ 7 to 12 db) or a broadband test antenna (80 to 1000 Mc, k = −1.2 to + 20 db) it forms the **VHF-UHF Field-Strength Meter Type HFU** BN 15002. The absolute voltage calibration is made with a tracking standardizing oscillator. The set is also usable as a selective valve voltmeter with 60 Ω input impedance, covering the voltage range 1 µv to 1 v with a signal-to-noise ratio of 10 db at the smallest bandwidth. Outputs for IF and recording are provided. The Type ESU is suitable for AC supply and battery operation.

The **Radio Interference Indicator Type EZS** BN 1531 can be connected to the IF outputs of field-strength meters or receivers (input requirement about 0.8 to 2 mv) for radio-interference measurements. Suitable intermediate frequencies are 2/10.7/15.7/21.4 Mc. The Type EZS permits measurements with weighting according to the German VDE 0876 recommendation. Suitable receivers are the Type ESU and the Types ESM 180, ESM 300 and ESG.

A 2d. Radio Receivers

Type E . . ., H . . ., BN 150 . . .

All the test and radio receivers quoted in this section may be counted among the communications equipments, but they have to be mentioned here to complete our survey of selective test receivers. Featuring calibrated output voltmeters and known gain, these sets are often used as field-strength monitoring calibrated output voltmeters and known gain, these sets are often used as field-strength monitoring equipments. However, they do not include a tracking standardizing oscillator. All receivers permit accurate frequency measurements since crystal-controlled standardizing oscillators are incorporated.

The **Short-Wave Receiver Type EK 07,** covering the frequency range 0.5 to 30 Mc in 12 bands, is suitable as communications and monitoring receiver under difficult conditions of reception in mobile and fixed radio stations, particularly in large stations. In conjunction with accessory units it permits reception of all types of modulation (Fig. 4). High setting accuracy and selectivity (3 tuned input circuits) and a good noise figure (less than 10 kT_0 or 10 db) are outstanding features*. The **Field-Strength Meter Type HFH** BN 15001 described above operates in roughly the same frequency range.

The **VHF Receiver Type ESG** BN 15075 operates in the frequency range 30 to 330 Mc. This AM-FM receiver for radio monitoring permits frequency-band recording, field-strength checking, remote modulation monitoring, radio-interference measurements, oscilloscopic checks and laboratory measurements. The voltage range is about 1 µv to 500 mv with 10 db signal-to-noise ratio. The two **VHF Monitoring Receivers Type ESM 180** BN 15073/2 and **ESM 300** BN 15074/2 covering respectively 30 to 180 Mc and 85 to 300 Mc (Fig. 4) are somewhat simpler sets. They are designed for AM-FM demodulation and include a BFO. Field-strength indication is also possible. The IF is brought out; the demodulated IF up to 100 kc bandwidth is also available for connection of an oscilloscope.

The widest frequency range, 25 to 900 Mc, is covered by the **VHF-UHF Test Receiver Type ESU** BN 150021, which has already been mentioned among the field-strength measuring equipment.

A 2e. Special Receivers

Type E . . ., N . . ., U . . .

The following receivers may be considered as selective measuring receivers in a wider sense, but they are too highly specialized to be used in practice for this purpose.

* See Kurzinformation 2/61.

The **VHF-FM Receiver Type ESB** has been developed for broadcasting and carrier-frequency operation; it is used in different models in broadcasting, as a relay receiver for television sound, long-distance receiver for carrier-frequency system or broadcasting programmes, and short-distance receiver for carrier-frequency or broadcasting relay stations. The **Receiver Type EU 038** is designed for television picture relay reception. The **Receiver Type EU 89,** frequency range 100 to 156 Mc, and the **Receiver Type ED 80,** frequency range 225 to 400 Mc, are designed for air-traffic control and used in fixed and mobile ground stations.

The receivers mentioned under A 2d are treated in more detail among the communications equipments.

Table of Selective Voltmeters and Test Receivers

1	2	3	4	5	6	7			8	9	10
Type	BN	Use	Frequency range	Voltage range	Inherent noise µV	BFO 1st IF	2nd IF Mc	3rd IF	Selectable bandwidths kc	Type of demodulation	Fig.
UBM	12121/2	A	45 cps . . 600 kc	6 µV . . 50 V	2	–	–	–	0.3 . . . 2 . . . 10‰; 100‰	—	1
ASV	1372	A	30 . . . . 300 Mc	0.5 mV . . 3 V	1 . . . 3.4	–	–	–	1%	AM	1
FTA	48302	V	30 cps . 20 kc	10 µV . . 100 V	0.3 . . 2.5	0.06	–	–	0.006/0.2	—	1
FNA	48301	V	30 cps . 20 kc	1 µV . . 100 V	0.3 . . . 3	0.06	–	–	0.01/0.2	—	1
USVH	1521	V	10 kc . . . 30 Mc	0.5 µV . . . 1 V	0.15	1.65 40	0.05 1.65	– 0.05	0.5/5	AM	1
USVF I + III	1528	V	Band I & III	0.2 mV . . 1.5 V	–	30	1.65	–	8	AM	2
USVF IV/V	15285	V	Band IV & V	0.3 mV . . 1.5 V	–	70	30	1.65	8	AM	2
USWV	15221	V	30 . . . 400 Mc	10 µV . . 1 V	3	10.5	–	–	125	AM	1; 2
USVD	1523	V	280 . . 940 Mc 940 . . 4600 Mc	12 µV . . 30 mV 100 µV . . 30 mV	4	25	–	–	2000	AM	2
USVU (HFA)	1524	V. F	0.9 . . 2.7 Gc	10 µV . . 30 mV	3	250	25	–	2000	AM	2; 3
HFH	15001	F. V. E	0.1 . . 30 Mc	0.1 µV . . 0.1 V	0.03	0.46 1.65	0.062 0.062	– –	0.2/1/8	AM	3; 4
HUZ	15012/2	F V	47 . . 225 Mc	5 µV . . . 100 mV	1	10.7	–	–	100	AM;FM	3
HUZD	15014	F. V	430 . . 610 Mc	50 µV . . . 0.5 V	–	100	–	–	800	FM	3
ESU (HFU)	150021	E. F. V	25 . . . 900 Mc	1 µV . . . 1 V	< 0.3	21.4 76	2 21.4	– 2	25/120*	AM; FM	3; 4

Table of Receivers

Type	BN	Use	Frequency range	Range of indication	Noise figure kT$_0$	BFO 1st IF	2nd IF Mc	3rd IF	Selectable bandwidths kc	Type of demodulation	Fig.
EK 07		E	0.5 . . 30 Mc	1 µV . . . 0.1 V	< 10	0.3 3.3	– 0.3	– –	0.3/0.6/1.5 3/6/12	AM;(FM)	4
ESM 180	15073/2	E	30 . . . 180 Mc	5 µV . . . 0.1 V	< 10 (25)	21.4	3.4	–	40/200	AM; FM	4
ESM 300	15074/2	E	85 . . 300 Mc	5 µV . . . 0.1 V	< 15 (35)	21.4	3.4	–	40/200	AM; FM	4
ESG	15075	E	30 . . 330 Mc	1 µV . . . 0.1 V	< 10 (25)	15.7 30 . . 120	– 15.7	– –	25/150/300	AM; FM	4
ESB		E$_s$	Bands I, II & III	10 µV . . . 10 mV	ca. 10	10.7 21.4 (Band III)	–	– –	150	FM	4
EU 038		E$_s$	Bands I & III	100 µV . . . 50 mV	< 10	33.4 S 38.9 P	– –	– –	15 Sound 5500 Picture	FM Sound AM Picture	4
EU 89		E$_s$	100 . . 156 Mc	–	< 10	19	1.65	–	46*	AM	4
ED 80		E$_s$	225 . . 400 Mc	–	ca. 10	39.6	1.65	–	46*	AM	4

Re column 3

A = tunable indicating amplifier
V = selective valve voltmeter with absolute voltage calibration
F = field-strength meter
E = radio receiver
E$_s$ = special receiver

Re column 6

The noise voltages given in column 6 refer to the bandwidth underlined in column 8. The kT$_0$ values in parentheses refer to the highest frequency range.

Re column 8

The bandwidths marked * refer to 6 db drop.

Re column 9

AM = set is suitable for amplitude demodulation (A_2, A_3)
FM = set is suitable for frequency demodulation (F_2, F_3)

The Types HFH, ESU, EK 07, ESM 180, ESM 300 and ESG have a BFO in addition.

To be continued

Spa.

Rohde & Schwarz Representatives' Meeting

At the end of September 1961, a meeting was held on the premises of the Rohde & Schwarz company in Munich, on the occasion of which the delegates of our export distributors came together. The purpose of this representatives' meeting, which takes place every 3 years, is to demonstrate the technical state of our measuring instruments and communications equipment, to determine the common sales policy and to establish personal contacts.

On September 27, the meeting was opened by the owners of the firm, Dr. Dr. h. c. L. Rohde and Dr. H. Schwarz. In his opening speech, Dr. Schwarz gave a survey of the business situation of the firm and pointed out to the growth of the factory during the last few years. Dr. Rohde reported on new tendencies in the development of modern measuring instruments and communications equipment and the consequences thereof for the production of high-precision instruments.

During the first two days, several newly developed instruments were demonstrated in the course of a number of lectures and discussions, among others instruments used in television engineering (Types OHF, OVF, OMF, AMF, SBTF), instruments for swept-frequency measurements (Types SWOB + USWV, Type ZWC), for phase measurements (Type DPF), for decade frequency measurements, for standard frequency engineering, for short-wave reception, and for reception and direction finding in air-traffic control. Further conferences dealth with the international efforts towards standardization of the sound-level measurements, with the meaning and the limits of characteristic-impedance specifications and with the problems of connector adaptation. During the last day of the meeting, problems concerning distribution, time schedules and advertising were treated.

The discussions, which were often quite exhausting, were followed by evenings dedicated to recreation and entertainment, where many personal contacts were established among our representatives from all countries. A trip made at the weekend through the lovely landscape of Upper Bavaria closed the meeting which had been held in a very harmonic atmosphere.

Supplement to the Instructions Given in No. 2/61 for the Medification of the Receivers Types ESM 180 and ESM 300

The instructions given in No. 2 for the modification of the IF output of the VHF Monitoring Receivers Types ESM 180 and ESM 300 apply only to such instruments which have been supplied by us after 1956, i. e. to instruments with the serial numbers

F 1049/...
F 1098/...
F 1126/...
F 1202/...
F 1278/...
F 1350/...
Type ESM 180

or

F 1050/...
F 1095/...
F 1127/...
F 1203/...
F 1279/...
F 1351/...
Type ESM 300

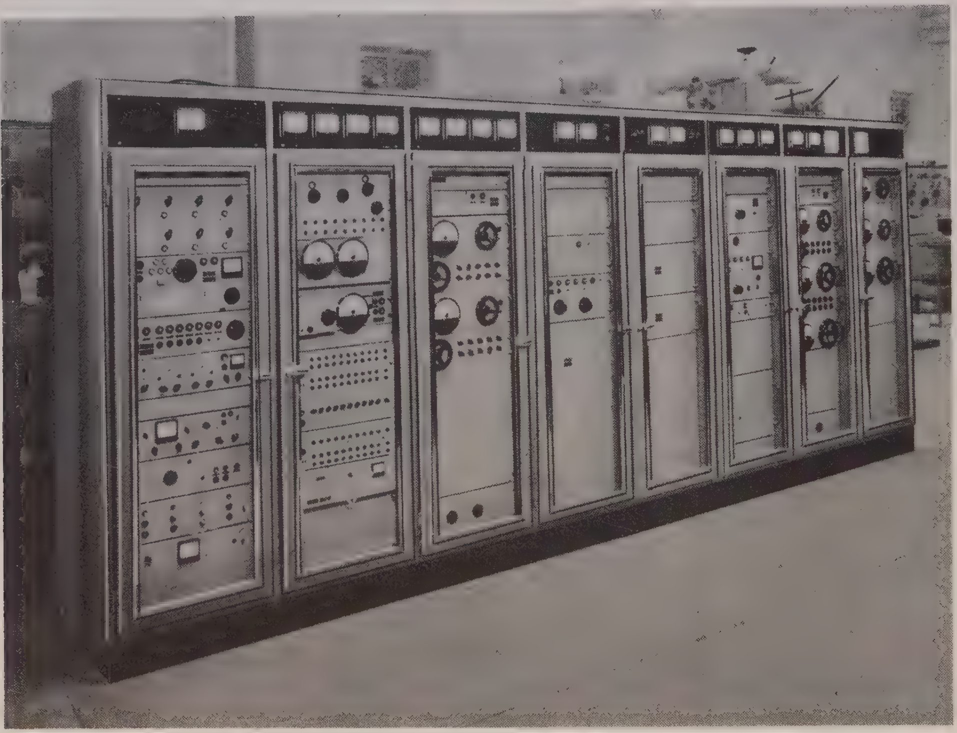
In addition, the instruments supplied in 1956, which bear the serial numbers F 1000/... or F 1001/..., can be modified in the described manner, provided they have an IF output on the front panel.

All earlier instruments, whose serial numbers are lower than those listed, have no IF output on the front panel. If an IF output for radio-interference measurements becomes necessary for these instruments, it must be subsequently incorporated. In this case, the instructions for the modification given in No. 2/61 can only be used as an approximate guide, since the IF section differs in its mechanical design from the drawing. The cathode of the valve 7 is tapped according to Fig. 1 in No. 2/61. A load connected to the IF output may have an effect on the performance.

Strößenreuther

The Short-Wave Transmitter Station Grimeton, Sweden

At the beginning of the year 1961 a single-sideband short-wave transmitter station was handed over to the Swedish post authorities at Grimeton, about 100 km south of Göteborg.



The Transmitter

Optimum use is drawn from long-distance systems if three requirements are fulfilled:

(a) rapid frequency change, therefore
(b) antennae covering a broad frequency band,
(c) directional antennae with rotatable main direction of radiation.

The transmitter station built by Rohde & Schwarz exhibits these three features. A 35-kw transmitter with frequency synthesis and preselection of 10 frequencies is used. The logarithmic periodic antenna of very large bandwidth presents a directional effect and is rotatable.

A. The Transmitter

The transmitter carries the type designation SK 35/963 and delivers an RF peak output power of 35 kw in the frequency range 4 to 28 Mc. The types of modulation A1, A2, A3, A3b, A4, A3 + F1, A3 + F6, F1, F2, F4 and F6 are provided *. The preferred type of modulation is single-sideband telephony with reduced carrier and two independent sidebands (A3b).

Transmitters of this type series are mainly used in those radio links where frequency changing within a short time, high frequency stability and setting accuracy, and great versatility with respect to the types of modulation used in commercial services are required. The frequency setting is made at the decade exciter by means of switches. The lowest decade is divided into 10-cps steps. All frequencies obtainable are derived from a 1-Mc crystal of high stability (better than 1 part in 10^7 per day).

The remote frequency selecting device of the transmitter makes it possible to select and preset by means of suitable storage facilities 10 frequencies within the range 4 to 28 Mc. The 10 preset frequencies, or channels, can be selected in an arbitrary order by means of a telephone dial. The maximum time elapsing in automatic frequency changing between the instant when the dial starts running and

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* For the designation of the types of modulation see Kurzinformation 2/61.

the instant when the transmitter is back on the air in 16 seconds at the utmost. The remote selecting device also provides for the selection of the types of emission A3b and A1 and of the operating conditions OFF, STANDBY, ON. Independently of the automatic frequency selecting device it is possible to set any frequency by hand without changing the preset storage facilities.

The Grimeton transmitter station is operated from Stockholm via a distance of about 500 km. The transmission of the setting commands and the signalling of the selected frequency and condition of operation require separate channels.

The transmitter is accommodated in a 8-bay cabinet rack. The bays 1 and 2 (from the left in the photograph) contain the exciter, the units for the preparation of the different types of modulation, remote selection receiver and transmitter, and the RF preamplifier, while the bays 3 to 5 house the driver for the 35-kw amplifier with automatic setting device and HT power supply.

The 35-kw amplifier with the associated automatic setting device is in the bays 6 and 7, the antenna transformer 60 Ω unbalanced to 600 Ω balanced in bay 8. A separate 4-bay rack contains the equipment for the anode supply of the 35-kw amplifier.

The power valves of the 35-kw amplifier and the driver are cooled by blowers which are separated from the transmitter and so dimensioned that the interior of the cabinet rack is under overpressure.

The selection of the 60-Ω or the 600-Ω antenna is made by means of an automatic antenna switch, which is included in the remote selecting device together with a channel register.

B. The Antenna System

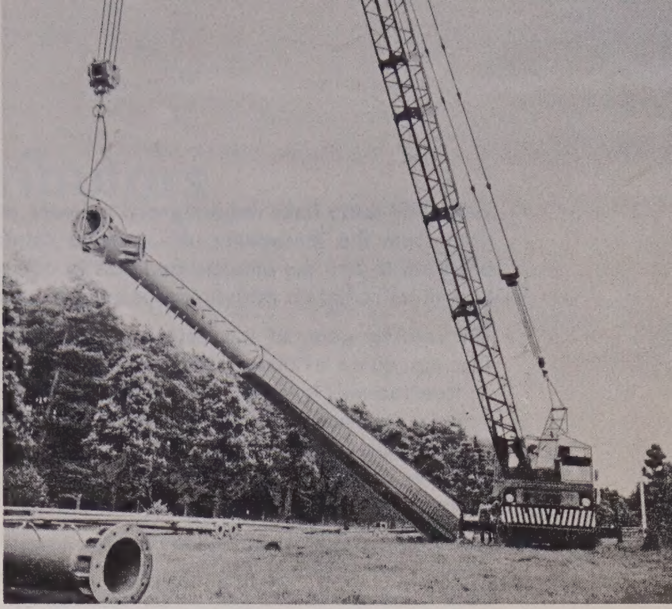
The short-wave directional antenna system erected at Grimeton operates in the frequency range 5 to 30 Mc and is dimensioned for a maximum transmitter output power of 35 kw (see title page).

The antenna system has a total height of 43 metres and is comprised of:

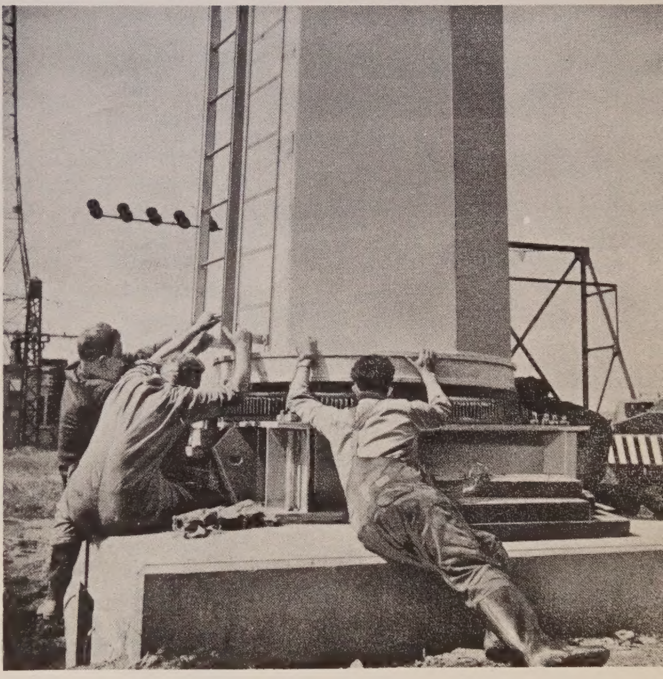
(a) Antenna Type HA 226/101

(b) Antenna Rotator (rotary mast and remote control unit) Type HA 55/61.

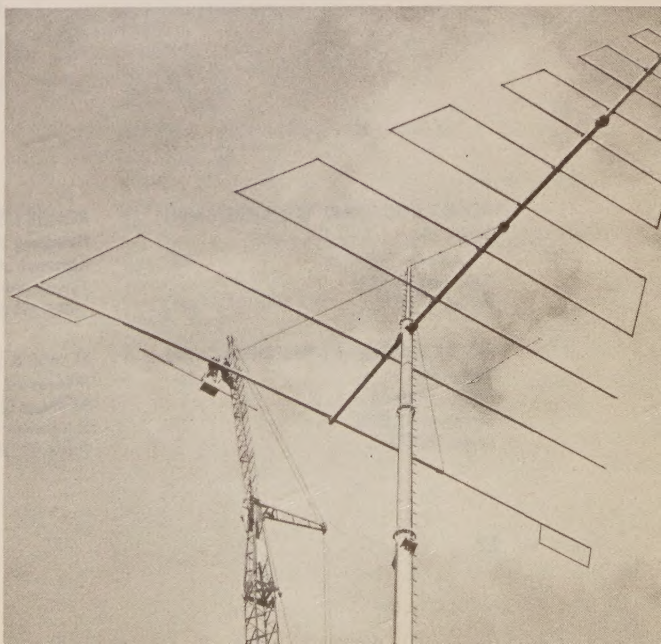
The main lobe of radiation lies in the direction of the antenna apex in the horizontal plane. The vertical radiation pattern is somewhat tilted by the influence of the soil. The antenna is excellently



Erection of the antenna mast



The rotating ring of the antenna mast



Mounting of the radiators

suited for radio links requiring one or more reflections from the ionosphere. An antenna rotator is provided to turn the antenna and thus to adjust the horizontal radiation pattern for the desired azimuth.

The feeding point of the antenna is at the apex. The impedance of about 180 Ω at the feeding point is transformed to 60 Ω by means of a coaxial exponential transformer. This transformer is fixed to the centre support of the lower antenna fan and is in the vicinity of the feeding point in the centre support.

The antenna size is determined by the lowest frequency, the length of the greatest elements being about half a wavelength, while the highest frequency depends on how far the antenna structure is continued towards the feeding point (apex). A limit is fixed by the power to be radiated, which requires certain minimum spacings.

The antenna and the rotary mast are designed for a wind velocity of 150 km/h. It is possible to climb on the centre supports of the upper and lower antenna fans. The rotary mast, 17 m in height, is a self-supporting solid-wall structure. It is carried by a ball-bearing supported rotating ring, which is connected to the square foundation through a broad-flange base. The rotary mast is driven by a geared motor fixed sideways to the rotary ring. The rotary mast can be climbed inside and outside. The remote control unit, indicating the antenna position by means of a synchro system, is located in the transmitter building. The total weight of the antenna system without foundation is about 16 metric tons.

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